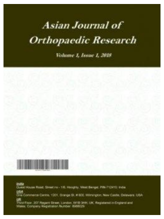

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Effects of Ergonomic Training and Active Exercises for Non – Specific Work Related Upper Extremity Musculoskeletal Disorders in Women Working in Video Display Units

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Authors' contributions

This work was carried out in collaboration among all authors. Author KS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors Vishnupriya and Hemalatha managed the analyses of the study. Authors Kamali and IPK managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Background: Work related upper extremity musculoskeletal disorders (WUEMSD's) are common causes of pain and functional limitations of upper extremity and it can lead to significant distress and disability in women working in video display units (VDU's).
Objective: The purpose of this study was to examine whether Ergonomic Training (ET) or Active Exercises (AE) would be more effective in decreasing pain and improving disability in women with WUEMSD's working in VDU's.
Methodology: 40 women with WUEMSD's were allocated into two groups. Ergonomic Training Group (ETG) received Ergonomic Training (n=20) and active exercise group (AEG) received Active Exercises Training (n=20) for 45 minutes on first contact session only. Ergonomic booklet was given to ETG and exercise booklet was given to AEG separately. They were advised to adhere to

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ergonomic advices and active exercises for 45 minutes/day for 4 months regularly based on booklet. Subjects were initially assessed prior to randomization, and at 2nd and 4th month follow-up. The following variables were evaluated: Pain and disability of upper extremity using NPRS and Quick DASH score respectively.

Results: Although both groups exhibited improvement in pain and disability at the 2nd and 4thmonth follow-up sessions ($p<.05$) compared with baseline measures, but there were significant differences between groups only on pain outcome in AEG, whereas no significant improvement noted between groups on disability ($p>.05$).

Discussion and Conclusion: The findings of this 4 month follow-up study allow us to conclude: Both groups improved on pain and disability at 2nd and 4th month follow-up assessments. These findings indicate that active exercises group is more effective in relieving UE pain, whereas no significant difference was found between the ergonomic training group and active exercises group in decreasing disability.

Keywords: Work related musculoskeletal disorders; upper extremity pain; video display unit; active exercises; ergonomic training.

1. INTRODUCTION

Video display units (VDU's) are boon to the present world for its speed and responsiveness. Computers become more often a part of the business and day to day life for its efficiency and productivity. But computer users are often prone to get shoulder, neck, arm and hand pain due to forceful or awkward hand movements, poor posture, badly designed work stations, fast paced workload and these factors set the individual more prone to acquire work related upper extremity musculoskeletal disorders (WUEMSD's).

In general, the use of computers in office or classroom environments limits bodily movements. Hence it affects a person's posture and leads to various posture related injuries, for instance, aches and pains in the back, neck, shoulder, arm, elbow, wrist and fingers. Musculoskeletal injuries in computer users are an increasing occupational health and safety issue as the use of computers proliferates throughout the various levels of organizations [1].

Studies indicate a higher prevalence of musculoskeletal disorders (MSD) among VDU users compared with non-VDU users [2]. WUEMSD's are the most common occupational disorders around the world, and have been recognized as a problem since the 17th century [3].

Musculoskeletal problems are commonly described as cumulative traumatic disorders, repetitive strain injuries, repetitive use injuries, occupational overuse disorders, and repetitive motion disorders. These musculoskeletal injuries are known as Occupational Overuse Syndrome (OOS) and were formerly known in Australia as Repetitive Strain Injury [4]. Other general terms for these disorders include repetitive strain injury, occupational overuse syndrome and cumulative trauma disorders [5]. These are also known as complaints of the arm neck and/or shoulder (CANS) [6].

WUEMSD's are work related musculoskeletal disorders of neck and upper limbs, which include the shoulders, upper arms, elbows, forearms, wrists and hands. They are common causes of pain and functional limitations and can lead to significant distress and disability. It can be further divided into specific conditions with clear diagnostic criteria and pathological findings or non-specific conditions where the main complaint is pain and/or tenderness with limited or no pathological findings [7]. Soft tissue injuries due to WUEMSDs are categorized into three. They are:

a. Tendon, ligament, muscle disorders,
b. Nerve disorders and
c. Impaired circulation.

These may lead to tendinitis, tenosynovitis, Dequeverian syndrome, trigger finger, carpal tunnel syndrome, Epicondylitis, ganglion cyst, reflex sympathetic dysfunction, Duputryen's Contracture, fibromyalgia etc. [8].

WUEMSDs often occur due to work stress, prolonged adaptation of faulty posture , highly repetitive work, work intensity, aging and loss of tissue resilience(e.g. inadequate strength, poor posture), physiological changes, anatomical changes, muscle tension, overloading and psychosocial factors (e.g. poor work-rest cycle, shift work, low job security, little social support). The risk factors are of two categories, they are intrinsic and extrinsic factors [9]. Intrinsic factors are caused by body structure, disease, and work habit. The extrinsic factors are caused due to work station configuration, type of work, type of environment [10].

The WUEMSDs can be reduced by reducing the impact of risk factors. The risk factors can be reduced by increasing the rest breaks in between work, break up work periods into several short sessions, adopt proper posture in work place, exercises in work place during rest period to relieve pain and improve efficiency.

Interventions such as ergonomic adjustments and exercises play a major role in treatment of the most WUEMSDs. The International Ergonomics Association (IEA, 2003) defines ergonomics (human factors) as the scientific discipline concerned with the understanding of the interactions among humans and other elements of a system, and the profession that applies theory, principles, data, and methods to design in order to optimize human well-being and overall system performance [11].

Ergonomics in the workplace refers to interactions among workers and other elements in the working environment. It is essentially about fitting the job to the worker [12]. Ergonomic training (ET) includes training in the identification of risk factors for WUEMSDs, proper work practice, selection of appropriate equipment's, correct use of equipment's, and work station adjustments [13]. Physiotherapist enables the video display unit workers to know about the principles of balanced alignment so they are able to incorporate proper posture. Good posture needs to be exercised regularly and consistently. Good posture plays a crucial role in preventing injury, but bad posture can be extremely difficult to change [14].

Outcome studies for active exercises in management in patients with WUEMSDs are inadequate. Muscles work in unison, so one must learn to stretch and strengthen corresponding muscle groups to work harmoniously in physiotherapy. The classic imbalance in computer professionals is a neck strained forward, rounded shoulders, and a slumped concave sternum. The overtly taut muscles in the front pull the shoulders forward, and this causes the muscles in the back to overstretch and weaken. Stretching and strengthening exercises reverse the injury process and promote healing with enhancement in efficiency at work. Only few studies have examined the treatment outcomes for upper extremity disorders and none has focused on WUEMSD's [15,16].

Purpose of this study is to find effective management of WRUEMSDs by analyzing the effects of ergonomic training and active exercise, then comparing the effectiveness in WUEMSDs in women working with VDU's.

2. METHODOLOGY

2.1 Study Design

- Experimental study design.

2.2 Sample Size Calculation

- An estimated sample size was calculated based on a large effect size and power of 80% utilizing IBM SPSS version 19.0 for Windows. Results indicated that an estimated sample size of 40 (20 per group) was required to achieve 80% power for all outcomes at the 5% level of significance.

2.3 Participants

- Forty female subjects with WUEMSD's who were working with video display units in PSG hospital and College campus were recruited after obtaining ethical clearance.
- Subjects were recruited based on the following inclusion criteria: Age range of 30-60 years, subjects with complaints of Non-specific WUEMSD's based on Cornell Musculoskeletal Disability Questionnaire for sedentary female worker (CMDQ) with baseline value of 27.5(Only upper limb component was included) and 3 years or greater experience in using video display unit work for working a minimum of 4 hours a day for 5 days a week or 20 h weekly. CMDQ consists of three parts, namely personal information, job task and other information as well as the body discomfort checklist.
- Subjects with co-morbidities known to influence the results were excluded. They

are Pregnancy, Cardiac problems, Rheumatoid arthritis, acute trauma or whiplash injuries, Neoplasms or inflammatory or neurological diseases, previous history of major trauma or surgeries in upper extremities and Subjects who have taken treatment for the same complaint during the preceding 6 months.

2.4 Procedure

- Forty patients who were eligible for study were randomly assigned to one of the following two groups: Ergonomic training group (ETG) (n=20) and Active Exercise group (AEG)(n=20). Prior to measurements, all included patients signed informed consent form. The randomization was done using computer generated random sampling method. The participant's flow of follow-up evaluation from 2 month till the 4-month follow-up is illustrated in Fig. 1.
- The baseline assessments were taken, which included age, BMI, duration of job, WUEMSD's duration and CMDQ, NPRS and Quick DASH. There was no significant difference in baseline measurements between the groups in terms of age, BMI, duration of job, duration of VDU usage and CMDQ score. (p=0.44, p=0.68, p=0.39, p=0.57 & 0.24) respectively. The intervention was given accordingly to their respective groups for 45 minutes only on the first session only. The intervention was followed by the subjects themselves with weekly monitoring of the therapist to check are they performing the exercises regularly and to correct any mistakes in their workstation exercises. The follow-up assessments were taken at the end of 2nd month and 4th month. The demographics of the participants at baseline are summarized in Table 1.

2.5 Intervention

- On the first session, ergonomic training and active exercises were taught for each group respectively for 45 minutes for each individual. The individuals were asked to follow the exercises for the 4 months duration in their work break for at least 15 minutes, 3 times a day. A Log dairy was maintained to mark the exercises were done without fail.

2.5.1 Ergonomic training (ET)

- The goals of ergonomic training were to improve the computer user's knowledge of office ergonomics, to teach workstation self-assessment, and to enable self-adjustment and rearrangement of the office environment. The ergonomic intervention was undertaken immediately after completing the scoring of the outcome measures and followed guidelines in OSHA document 3092, "Working with Video Display Terminals," which describe head, trunk, UE, and LE positioning that is in agreement with current research regarding safe VDT working postures [31].
- In addition, booklets containing the ergonomic information about VDU terminal usage instruction were distributed at the start of each session to ensure a consistent delivery of information.
- ET is based on decreasing awkward postures that occur while the individual is performing work tasks. Observing individual's working posture at VDU'S was further assisted by visiting each participant's workstation and checking on the position of the monitor, height of the chair and desk, eye level, shoulder, elbow and wrist position and the support of the back, thighs and feet.
- Adjusting the height of the seat to monitor the viewing angle, Rempel et al, demonstrated that adding a perfectly suited, adjustable chair significantly reduced shoulder and neck pain in seated workers [30].
- The height of the seat were modified to allow proper positioning of the trunk and UE with the elbows at 80° of flexion, elbows higher than the keyboard, and neutral wrist position of 0° of flexion or extension while resting on the keyboard or mouse. This position is designed to decrease muscle activation during seated postures that is caused by constant low-level loading of the UE muscles. The mouse was arranged at the right corner of the keyboard to avoid excessive shoulder abduction, decrease muscle activation and fatigue [31]. The monitor height was positioned at proper eye level by using books/ riser, and the monitor was positioned directly in front of the patient's view to approximate the proper viewing angle and distance from the patient's eyes. A document holder was advised to reduce

head and neck movement and to reduce the chance that the individual would encounter a head tilt angle that put her at risk for neck pain. The individuals was instructed to take 20 second “micro breaks” as a means to break any sustained posture and relieve her symptoms by reducing myoelectric activity in the shoulder girdle musculature.

- Ergonomic training lasts around 45 minutes on first session and a short follow-up visit occurred every week after the initial ergonomic training. The ultimate purpose of the training was to deliver employees with sufficient ergonomic knowledge to evaluate and change their own work-stations appropriately, making the intervention self-administered [25].

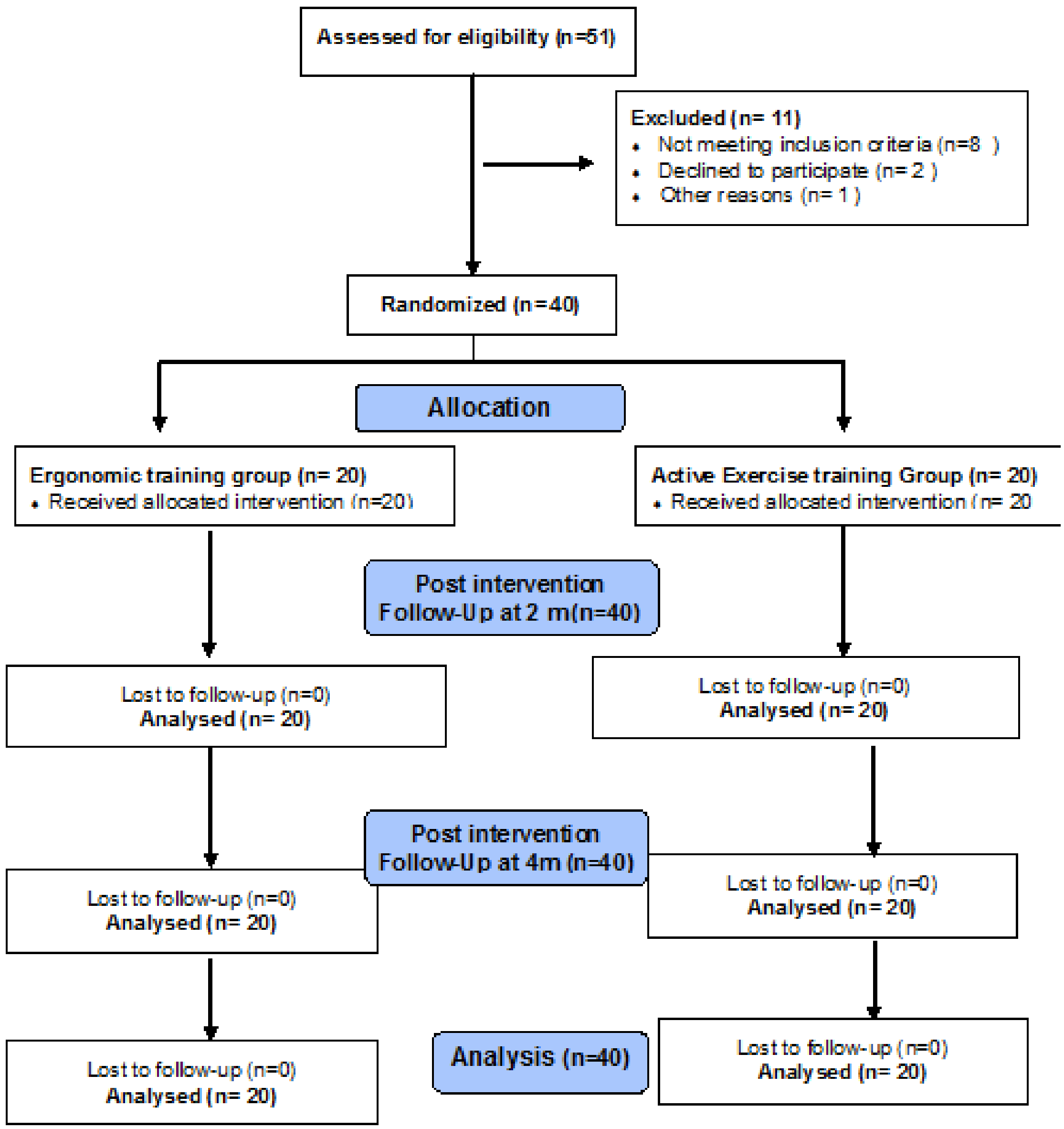

Fig. 1. Flow chart describing the numbers of participants for each group, from recruitment, to group allocation, treatment, follow up and analysis

Table 1. Baseline characterization of the study samples (n = 40)

Variable	Group		P value
	ETG (n=20)	AEG (n=20)	
Age, years (mean ± SD)	44.15±11.03	45.30±07.86	0.44
BMI, (Kg/m2)(mean ± SD)	27.80±4.62	26.95±3.12	0.68
Involved side, n (%)	17(85%)	18(90%)	0.83
• Right	01(5%)	01(5%)	(Chi Square)
• Left	02(10%)	01(5%)	
• Bilateral			
Duration of job (years)	11.05±4.54	9.95±3.41	0.39
Duration of VDU usage /day	6.04±.91	6.19 ±1.13	0.57
CMDQ	32.80±9.17	34.77±8.75	0.24

2.5.2 Active exercises (AE)

- Individuals in the active exercise group were educated to carry out a standardized exercise program daily on their own during their “work breaks”. Subjects underwent self-active exercises as taught, 3 times per day for 4 months during their “work breaks” for 15mins and provided with exercise booklet.
- The facilitators of the sessions explained the importance of ‘good and bad posture’ and taking ‘micro breaks’.
- Each ‘micro break’ consists of a 20-second period of standing stretches (active exercises for shoulder flexion, wrist flexion and extension, and scapular adduction) performed every 30 minutes while at her desk.The training covered the need for work break and stretching every 2h during VDU use.
- The therapists demonstrated simple exercises pertaining to neck, back, shoulder and arm, wrist and hand, leg and ankle. The Active exercise consists of ROM, stretching and strengthening of the muscles which are prone to develop tightness and predispose to abnormal posture and muscle pain.
- They were demonstrated how to perform the exercises accurately at first session, and again their progress was monitored during a weekly visit to the workplace. The exercise techniques performed by the participants were monitored during the first session of training. The exercises were tobe performed without significant provocation of neck and shoulder pain.
- An exercise booklet which contains the Exercise Information was distributed at the start of the first session to ensure a consistent delivery of information. The participants were requested to make entries on the log sheet as they did the exercises on a daily basis for about 4 months.

2.6 Outcome Measures

2.6.1 Numeric pain rating scale (NPRS)

Neck pain was measured using the numerical rating pain scale (NRPS). This is a self- report outcome measure where subjects rate their pain on a single 11-point scale from no pain 0 to severe pain 10 [17]. A two-point change in the NRPS has been identified as the minimal clinically important change needed to be confident that a change has actually occurred. The subjects indicated their pain by placing a vertical line through the NPRS score at the point that represented their levels of neck pain [18].

2.6.2 Quick disability of arm shoulder and hand questionnaire (Quick DASH)

The shortened Disabilities of the Arm, Shoulder and Hand Questionnaire (QuickDASH) is an 11-item questionnaire that rates physical function and symptoms in people with upper limb MSD’s. It is an abbreviated version of the 30- item original DASH. The 11 items of QuickDash address daily activities, house/yard work, shopping, recreation, self-care, eating, sleep, friends, work, pain and tingling/numbness.It is considered with a mean difference of more than 10 points on the DASH as a MCID [19]. Reliability and validity: Internal consistency (a = 0.92–0.95) and test-retest reliability (ICC = 0.93) of the QuickDASH are distinctive. In addition, the QuickDASH has a high construct validity (p = 0.84) when compared to the Shoulder Pain and Disability Index [20].

2.7 Data Analysis

Analyses of all data were carried out using the IBMSPSS version 19.0 for Windows. Descriptive statistics were used at baseline to determine demographic variables, which included age, BMI, Duration of job, WUEMSD's duration and CMDQ. Descriptive data will be presented quantitatively as means (± SD) for continuous variables and as medians for categorical variables. Repeated Measure ANOVA was used for within group pair wise comparison at 3 time intervals (baseline, 2nd month and 4th month follow-up) to determine whether there were significant differences in the NPRS and Quick DASH Scores A post-hoc test with Bonferroni's correction was used in multiple comparisons both between and within groups. Pain intensity and Upper limb disability between groups were analyzed by the independent sample "t" test. An overall p-value of less than 0.05 was considered to be statistically significant.

3. RESULTS

Totally 40 subjects were studied, in two groups to compare the effectiveness of ET and AE in women with WUEMSD's. The calculated repeated measure ANOVA for NPRS for Group A ($F=223.55$; $p<0.05$) and Group B ($F=148.68$; $p<0.05$). DASH for Group A ($F=35.692$; $p<0.05$) and Group B ($F=45.327$; $p<0.05$) for 3 time frames respectively. Pairwise comparisons using Bonferroni's correction indicated that there was a significant difference for time points for NPRS and Quick DASH at all-time levels, $p<0.05$ indicating that there was a decrease in pain and improvement in physical function of Upper extremity in both groups from baseline to 2nd month and 4 month. Pairwise comparison of NPRS and Quick DASH at baseline, 2 month and 4m follow-up for both groups were summarized in Table 2.

The calculated independent't' test value for NPRS shows there is significant difference between groups i.e., exercise is more effective than ergonomic intervention in reducing arm pain at 3 time intervals on 2nd and 4th month follow-up assessment, where p value ($p<0.05$) and independent't' test for DASH between 2 intervention has shown that there is no significant difference between the groups at three time intervals for physical function, where p value ($p>0.05$). The two Group outcome values at 2nd and 4th month follow-up are compared in Table 3. Comparison of NPRS & Quick DASH means score in both intervention groups were show on Fig. 2 and Fig. 3.

4. DISCUSSION

This study investigated the efficacy of musculoskeletal pain intensity and physical function of the upper limb in response to 4 months of Ergonomic training and active exercises at the workplace on pain in VDU workers with WUEMSD's. To our knowledge, this is the first study that directly compared the effects of 4months of ergonomic training with active exercise especially in women population who were working on VDU's. Past research has mainly compared Ergonomic Advices [16] with ergonomic training, relaxation training, or cognitive behavioral therapy, and frequently the outcome measures involved only pain and functional scores [17]. Forty women staffs who met the selection criteria were recruited as participants for this study. There were in their mean age of 44.72 years (24–74years).The Baseline characteristics revealed that duration of job in average of 11.05 years and 9.95 years respectively in each group. The Data showed that participants used the computer for an average of 6.1 hours /day (range: 4.3 hours to 8 hours) and they noted average of 6.05 pain intensity while using VDU's. The area of discomfort experienced by the participants was identified using the CMDQ (average: 26.18). On Overall effectiveness, our data suggest that the ergonomic intervention and Active exercises equally improves the pain, physical function during VDU usage, but while comparing both intervention active exercises seems to improve pain superiorly than ergonomic training.

Several other studies have investigated the effects of active exercise training and electrotherapy and found mixed results on their capacity to decrease pain [18] and improve neck and shoulder function [19]. Previous studies have recommended [20], the effects of combining various intervention strategies were not studied, but this may possibly produce even better results in terms of pain relief and improving physical function. This should also be investigated in future studies.

An early study compared active and passive physiotherapy for occupational cervico-brachial disorders with a 1-year follow-up. They mainly assessed tender points in the neck and shoulder muscles and maximum isometric extension force after physiotherapy [21]. A study by Chao Ma et.al., compared the effects of biofeedback with those of active exercise and passive treatment in treating work related neck and shoulder pain results showed the active exercises showed improvements but not superior to biofeedback, further they have mainly compared such as ergonomic training with biofeedback, but have not compared it with other types of interventions such as active exercises especially in the women population who work on VDU terminals more than 3 years [15]. Another study stated the impact of regular exercise at a work station on musculoskeletal discomfort in 11 VDU operators. The participants of the study who engaged in exercise reported a short-term reduction of musculoskeletal discomfort [22]. The results showed similar findings as the present study with a significantly greater reduction in NPRS.

Kietrys et al. investigated the effect of exercise at work (targeting neck, shoulders and the upper back) on 72 computer operators over a period of 4 weeks. They concluded that most subjects found the resistance and the stretching exercises easy to do, perform them 1 to 2 times daily and said they reduced discomfort. He also recommends further research to determine the optimal type and frequency of at- work exercise [23]. Similar results were demonstrated by Omer et al, also carried out a study on the effectiveness of training and exercise programs in the management of MSDs. They trained the participants in mobilisation, stretching, strengthening and relaxation exercises, and found that these exercises reduced reported experiences of MSD pain and depression levels within participants in the short term [24].

The active exercises group in this study consistently showed a greater reduction in average muscle activity amplitude than the other studies, as is evident in the Tables. The results of this study indicate that ergonomic interventions have a beneficial effect on working posture and workstation layouts. These findings are consistent with earlier studies [25-27], which indicated that ergonomic training and interventions resulted in alterations in working posture and workstation layouts. Feuerstein et al., (2004) reported a decrease in the intensity of WUEMSS after ergonomic training and workplace modifications at the end of 12-month follow-up [28]. Study results of Lewis et al. suggest that VDU office ergonomics training programs may be effective in enhancing workstation configuration/posture, thereby reducing musculoskeletal symptoms [25].

Table 2.Pairwise comparison of NPRS and quick dash at baseline, 2 month and 4m follow-up for both groups

Group	Outcome measure	Time (I)	Time (J)	Mean difference (I-J)	Standard error of mean (SE)	P*
Ergonomic Training Group (n=20)	NPRS	Pre training	2 month followup	1.25**	.123	.00
		Pre training	4 month followup	2.35**	.131	.00
		2 month follow up	4month followup	1.10**	.069	.00
	Quick DASH	Pre training	2month followup	9.00**	1.65	.00
		Pre training	4 month followup	17.41**	2.53	.00
		2month follow up	4month followup	08.41**	8.41	.00
Active Exercise Group (n=20)	NPRS	Pre training	2month followup	01.80	.200	.00
		Pre training	4month followup	03.15	.221	.00
		2 month followup	4month followup	01.35**	.135	.00
	Quick DASH	Pre training	2month followup	08.72**	1.37	.00
		Pre training	4month followup	15.88**	2.27	.00
		2 month followup	4month followup	07.16	1.14	.00

- *The mean difference is significant at the .05 level.*
- ***Adjustment for multiple comparisons: Bonferroni*

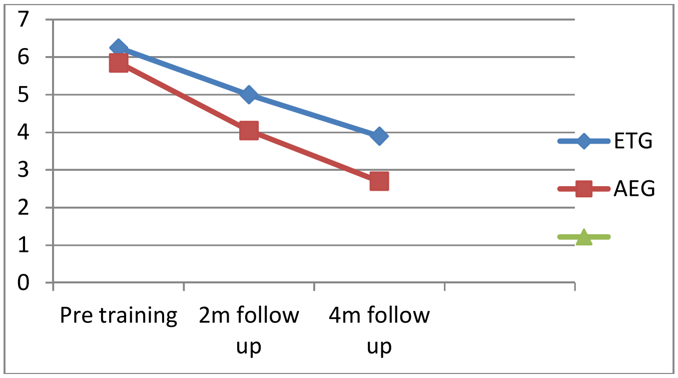

Fig. 2. Comparison of NPRS means score in both intervention groups

Table 3. Comparison of NPRS Vs Quick dash scores at 2nd and 4th month follow up

Outcome measure	Time interval	Group	Mean	SD	t	P
NPRS	Pre training	ETG	6.25	0.71	1.52	.13
		AEG	5.85	0.93		
	2nd month follow up	ETG	5.00	0.92	3.87	.00
		AEG	4.05	0.60		
	4th month follow up	ETG	3.90	0.91	4.59	.00
		AEG	2.70	0.73		
Quick Dash	Pre training	ETG	26.49	13.42	0.15	.88
		AEG	25.88	12.32		
	2nd month follow up	ETG	17.49	11.20	0.10	.92
		AEG	17.16	09.17		
	4th month follow-up	ETG	9.08	05.44	0.43	.67
		AEG	9.99	07.74		

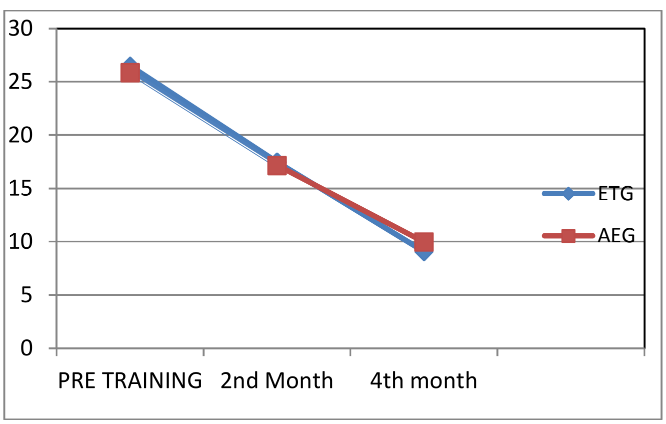

Fig. 3. Comparison of Quick DASH means scores in both intervention groups

Finally, the successful implementation of ergonomic training also depends on the compliance of learning capacity of the individual, because of single training session might be not sufficient [29]. In case of active exercises training, we suggest that these clinical significant results can be due to the following reasons: First, combination of stretching, strengthening was had previously shown to be effective in pain and disability reduction. Further, educated participants who complied with the study rules and protocols. Our study shows that ergonomic intervention together with active exercises can help to improve pain and physical function in persons with WUEMSD's.

5. STRENGTHS AND LIMITATIONS

The present study has both strengths and limitations. The strength of this intervention is that the program is specifically tailored to the needs of employees with WUEMSD's. Focus group sessions with employees identified the needs of participants related to disease-specific information, exercises, muscle relaxation, working with pain, work and social environment, and personal factors (including work style) and another advantage is, the intervention is a self-management based program. Another major strength of this study was the relatively random allocation of participants on the workplace levels to avoid potential confounding variables and crossover interactions between the two groups.

Despite this strength, our study had a number of Limitations. Some of the limitations were, the intervention was given only on the first session. Secondly, long-term effects on musculoskeletal pain and physical disability were not found in this study. On the other hand, it was practically impossible to prevent personal interaction between the groups about the interventions they were receiving, resulting in some misclassify-cation. The study was not blinded, leaving the possibility for investigator bias. Given that the same investigators analyzed workstations and provided the training, the intervention group scores were vulnerable to inflation. A final limitation might be that all data are self-reported. Therefore, as far as possible, we have used the validated questionnaires. To improve the level of pain and disability physically in VDU workplaces, the best result will be achieved by analyzing the work place and equitably providing ergonomic training and follow exercises to participants to avoid further musculoskeletal consequences [30].

6. CONCLUSION

In conclusion, this study reveals both the intervention for the management of WUEMSD's in VDU workers has improvements in pain, Physical function of UE after 2 and 4 months of intervention. The most compelling finding of this study was that the group that received the active exercise obtained the greatest average improvement on pain during 2^{nd} and 4^{th} month follow-up values than ergonomic training. These results support the importance of adopting interventions that target the active muscles which maintain muscle function rather than focusing only on ergonomic advice alone [31]. On the whole, the results indicate more favorable medium -term outcomes from active exercise compared with Ergonomic interventions on improving pain in women with WUEMSD's.

7. SUGGESTIONS FOR FUTURE STUDY

A separate group treated with both ergonomic and active exercise interventions can be added and this can be compared with ergonomic and active exercise group. Regular exercise and ergonomic training sessions can be given throughout the study. To investigate long follow up, the study can be extended beyond 4 months. Male workers can also be included in the study and, the effectiveness of interventions can be compared between Men and Women with WUEMSD's working on VDU's. We suggest using more objective assessment methods rather than self-reported measures, especially in evaluating the ergonomic exposure. Second, future studies should use larger sample sizes with longer follow-up periods.

CONSENT

According to the standards of the Declaration of Helsinki, all subjects provided written informed consent before data collection.

ETHICAL APPROVAL

Approval was obtained from the Institutional Human Ethics committee, PSGIMSR, Coimbatore. India. (Ref.No:16/364)

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COMPETING INTERESTS

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

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